B FURTHER EXPANSION

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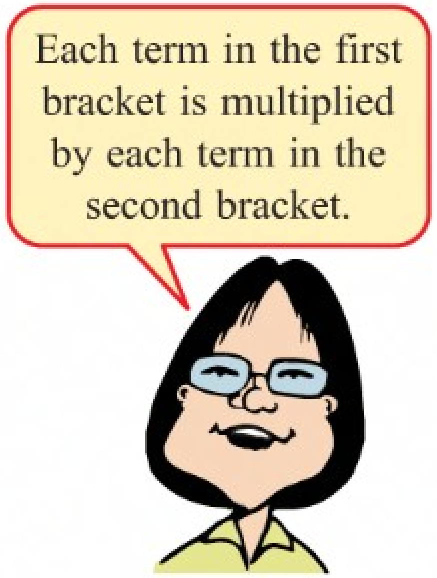
When expressions containing more than two terms are multiplied together, we can still use the distributive law to expand the brackets. Each term in the first set of brackets is multiplied by each term in the second set of brackets.

If there are 2 terms in the first brackets and 3 terms in the second brackets, there will be $2 \times 3 = 6$ terms in the expansion. However, when we simplify by collecting like terms, the final answer may contain fewer terms.

Example 5 **Self Tutor**

Expand and simplify: $(x+3)(x^2+2x+4)$

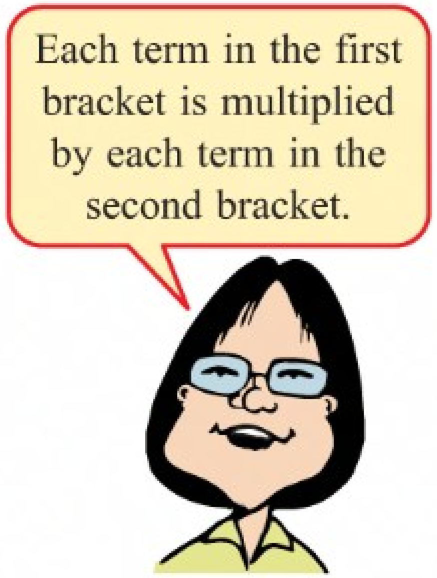

Each term in the first bracket is multiplied by each term in the second bracket.

Example 5

Self Tutor

Expand and simplify: $(x+3)(x^2+2x+4)$

$$
\begin{aligned}
&(x+3)(x^2+2x+4)\\
&= x^3+2x^2+4x && \{x \times \text{each term in 2nd bracket}\}\\
&\quad\; +3x^2+6x+12 && \{3 \times \text{each term in 2nd bracket}\}\\
&= x^3+5x^2+10x+12 && \{\text{collecting like terms}\}
\end{aligned}
$$


Each term in the first bracket is multiplied by each term in the second bracket.

1 Expand and simplify:

a $(x+2)(x^2+x+4)$
b $(x+3)(x^2+2x-3)$
c $(x+3)(x^2+2x+1)$
d $(x+1)(2x^2-x-5)$
e $(2x+3)(x^2+2x+1)$
f $(2x-5)(x^2-2x-3)$
g $(x+5)(3x^2-x+4)$
h $(4x-1)(2x^2-3x+1)$

Example 6

Self Tutor

Expand and simplify: $(x+1)(x-3)(x+2)$

Example 6

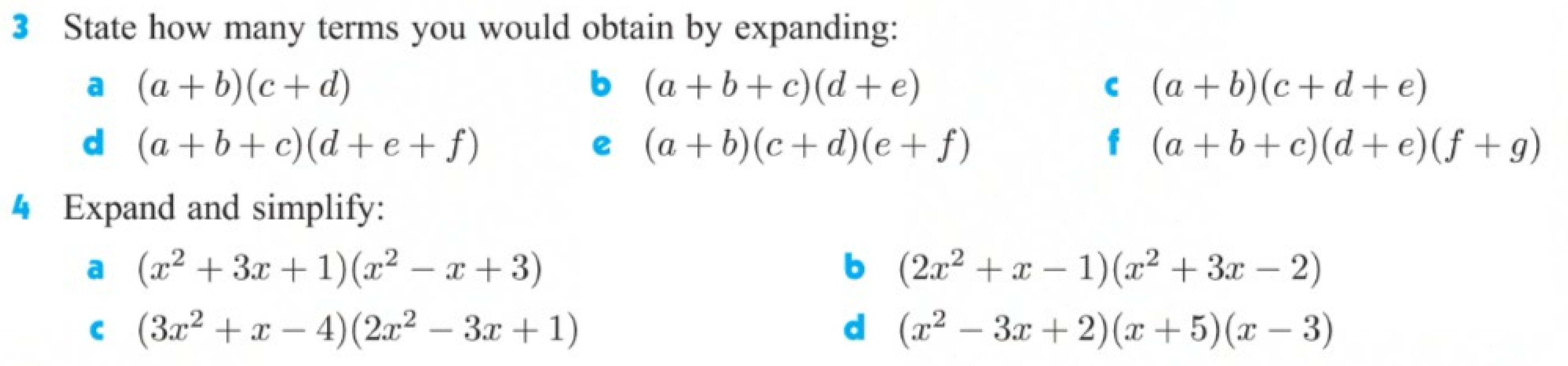
Self Tutor

Expand and simplify: $(x+1)(x-3)(x+2)$

$$\begin{aligned}
&(x+1)(x-3)(x+2) && \\
&=(x^2-3x+x-3)(x+2) && \{\text{expanding first two factors}\} \\
&=(x^2-2x-3)(x+2) && \{\text{collecting like terms}\} \\
&=x^3+2x^2-2x^2-4x-3x-6 && \{\text{expanding remaining factors}\} \\
&=x^3-7x-6 && \{\text{collecting like terms}\}
\end{aligned}$$

2 Expand and simplify:

a $(x+4)(x+3)(x+2)$
b $(x-3)(x-2)(x+4)$
c $(x-3)(x-2)(x-5)$
d $(2x-3)(x+3)(x-1)$
e $(4x+1)(3x-1)(x+1)$
f $(2-x)(3x+1)(x-7)$
g $(x-2)(4-x)(3x+2)$
h $(x+3)^3$
i $(x-2)^3$



3 State how many terms you would obtain by expanding:

a $(a+b)(c+d)$ **b** $(a+b+c)(d+e)$ **c** $(a+b)(c+d+e)$

d $(a+b+c)(d+e+f)$ **e** $(a+b)(c+d)(e+f)$ **f** $(a+b+c)(d+e)(f+g)$

4 Expand and simplify:

a $(x^2+3x+1)(x^2-x+3)$ **b** $(2x^2+x-1)(x^2+3x-2)$

c $(3x^2+x-4)(2x^2-3x+1)$ **d** $(x^2-3x+2)(x+5)(x-3)$

1 **a** $x^3 + 3x^2 + 6x + 8$ **b** $x^3 + 5x^2 + 3x - 9$
c $x^3 + 5x^2 + 7x + 3$ **d** $2x^3 + x^2 - 6x - 5$
e $2x^3 + 7x^2 + 8x + 3$ **f** $2x^3 - 9x^2 + 4x + 15$
g $3x^3 + 14x^2 - x + 20$ **h** $8x^3 - 14x^2 + 7x - 1$

2 **a** $x^3 + 9x^2 + 26x + 24$ **b** $x^3 - x^2 - 14x + 24$
c $x^3 - 10x^2 + 31x - 30$ **d** $2x^3 + x^2 - 12x + 9$
e $12x^3 + 11x^2 - 2x - 1$ **f** $-3x^3 + 26x^2 - 33x - 14$
g $-3x^3 + 16x^2 - 12x - 16$ **h** $x^3 + 9x^2 + 27x + 27$
i $x^3 - 6x^2 + 12x - 8$

3 **a** $2 \times 2 = 4$ terms **b** $3 \times 2 = 6$ terms
c $2 \times 3 = 6$ terms **d** $3 \times 3 = 9$ terms
e $4 \times 2 = 8$ terms **f** $4 \times 3 = 12$ terms

4 **a** $x^4 + 2x^3 + x^2 + 8x + 3$
b $2x^4 + 7x^3 - 2x^2 - 5x + 2$
c $6x^4 - 7x^3 - 8x^2 + 13x - 4$
d $x^4 - x^3 - 19x^2 + 49x - 30$